Occupational Hygiene
and
Biological Monitoring

Kate Ansell
MSc CMFOH CMIOSH
Area Senior Occupational Hygienist
Definition

• Occupational Hygiene
  – Identifying, evaluating and controlling exposure to workplace hazards

• Health Surveillance
  – “Periodic medico-physiological examination of exposed workers with the objective of protecting health and preventing disease”

• Biological Monitoring
  – “the measurement and assessment of agents or their metabolites either in tissues, secreta, excreta, expired air or any combination of these to evaluate exposure and health risk compared to an appropriate reference”.

[1980 joint EU, NIOSH and OSHA seminar]
Introduction

Health Surveillance

• The objective of HS is to check employees health to enable early detection of adverse changes which may be caused by exposure to hazardous substances
• Collect and keep up to date, and use data etc for determining and evaluating hazards to health so that action can be taken to prevent more serious disease development
• Check control measures are working effectively, and giving feedback on the accuracy of the risk assessment, and help identify where further risk management is needed.
Introduction

Biological Monitoring

• Biological monitoring is a way of assessing chemical exposures by measuring the chemical or its breakdown products in a biological sample (usually urine, blood or breath).
• Often used in conjunction with air sampling
Biological Processes
Inter-dependencies

- The relationship between environmental, biological and exposure monitoring, and health surveillance
Biological Limit Values (BLVs) and Biological Guidance Values (BGVs)

- These work like the Occupational Exposure Limits in EH40 and are either expressed as ‘limit’ values or ‘guidance’ values

- The BLV are guidelines and are the levels that might be expected from persons exposed by inhalation at the OEL

- The BGV represent the ‘upper concentration of the substance or a metabolite of the substance in any appropriate biological medium corresponding to ...a defined reference population’ i.e. may become the detection level if no background data can be found

- If BGV exceeded then more investigation of controls and working conditions are required
Current BMGVs UK

- Butan-2-one
- 2-Butoxyethanol
- Carbon monoxide
- Chromium VI
- Cyclohexanone
- Dichloromethane
- N,N-Dimethylacetamide
- Glycerol trinitrate
- Isocyanate

- Lindane
- MbOCA
- Mercury
- 4-methylpentan-2-one
- 4,4-methylenedianamile (MDA)
- Polycyclic aromatic hydrocarbons (PAHs)
- Xylene (+ mixed isomers)
Setting Up Biological Monitoring

1. Purpose of the survey/programme (health surveillance/exposure monitoring?)
2. Competent person to manage it (someone who understands the guide/access to specialist expertise – blood samples)
3. Define the strategy
4. Consult with employees / representatives
5. Discuss and agree programme/survey with employees
6. Establish procedures for collection, storage, transport and analysis of samples – quality assurance
7. Establish procedure for feedback, including interpretation of results
8. Ensure arrangements in place for acting on the results and evaluation effectiveness of programme
Blood, Breath or Urine?

• Breath and urine should be used preferentially
• Accurate breath sampling and analysis using a transportable respiratory mass spectrometer – not always available
• Breath not always convenient (smokers etc)
• Urine samples affected by:
  – Concentration (hydration levels), time of day
  – Required commitment to collect samples (24 hours)
  – Variability in subjects, metabolism, body weight etc.
## Sampling Strategy

<table>
<thead>
<tr>
<th>Half Life</th>
<th>Optimum Time for Taking Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 hours</td>
<td>Concentrations of the agent change too fast, consider measuring a metabolite with a longer half life</td>
</tr>
<tr>
<td>2 – 10 hours</td>
<td>End of Shift or next morning</td>
</tr>
<tr>
<td>10 -100 hours</td>
<td>End of shift at end of week</td>
</tr>
<tr>
<td>Greater than 100 hours</td>
<td>Random samples are acceptable</td>
</tr>
</tbody>
</table>
Analysis

- Use accredited laboratories
- Can use simple CO2 monitors (health centres)
- Breathe into bags and sample exhaled breath (use Drager or Gastec tubes, or Mass Spec)
Factors Affecting Absorption

- Individual build and fitness, breathing rate and work load
- Work practices – use of PPE and RPE, efficiency of protection
- Absorption and retention of fat soluble materials is also affected by an individual's amount of body fat
- These biological factors result in considerable variability in the extent of absorption during any specified task
- Biological monitoring useful + air monitoring in assessment of individual risk

- Confounding factors – baseline measurements, mixed exposures and cumulative body burden
Consent

- Have to get employers and employees consent if separate to the health surveillance aspects of Reg 11 of COSHH [person has to attend an appointment if required]

- Taking biological samples

- Protect identity and information

- Sharing appropriately and with permissions.

- HSG 167 – Biological Sampling in the Workplace
Focused Assessment

Advantages

• Extended exposure time
• Mobile worker
• Absorption of substance by number of routes
• All sources – occupational and environmental
• Work effort, ventilation, climate factors in quantity absorbed

Limitations

• Small number of substances
• Are results from current or historical exposure (Cd and Hg)
• Degree of exposure not organ burden
• Metabolism interferences
• Alcohol
• Smoking
Summary

• Biological monitoring is a useful adjunct to environmental monitoring (occupational)
• Measures exposure by ALL routes (how much absorbed)
• Exposes potential failures in control measures particularly where reliance is on PPE/RPE, also where control adequate
• To evaluate implementation of controls and if improvements have reduced exposure
• Can provide useful baseline information for long term cumulative exposure studies
• Limited to specified substances
• Indication of exposure where OEL not exceeded
• Provides reassurance to workers that their personal exposure is under control